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Sand and gravel extraction



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Citation:

Van Lancker, V., Lauwaert, B., De Mol, L., Vandenreyken, H., De Backer, A., Pirlet, H., 2015. Sand and gravel extraction. In: Pirlet, H., Verleye, T., Lescrauwaet, A.K., Mees, J. (Eds.), Compendium for Coast and Sea 2015: An integrated knowledge document about the socio-economic, environmental and institutional aspects of the coast and sea in Flanders and Belgium. Ostend, Belgium, p. 105-114.

Up to 100 million m³ of marine sediments are extracted annually in the OSPAR Region (Northeast Atlantic Ocean and North Sea). These are mainly sand and gravel for the construction industry and beach nourishments. Furthermore, marl is extracted to improve farmland and to filter water ([OSPAR QSR 2010](#)). Most of the marine sediment is extracted in the North Sea by countries such as the Netherlands (23.2 million m³ in 2013), the United Kingdom (16.0 million m³ in 2013), France (12.5 million m³ in 2013) and Denmark (7.7 million m³ in 2013) ([Report of the Working Group on the Effects of Extraction of Marine Sediments on the Marine Ecosystem \(ICES, WGEXT\) 2014](#)). In the Belgian part of the North Sea (BNS), most of the extracted sediment is sand with an annual volume that fluctuated in the last ten years between 1.5 and 3 million m³ and amounted to more than 5.5 million m³ in 2014 (Source: FPS Economy, Continental Shelf service). Due to the low quantities in extraction areas, gravel is not extracted ([Brochure Continental Shelf service 2014](#)).

4.1 Policy context

The sand and gravel extraction in the BNS is a federal competence that belongs to the FPS Economy, SMEs, Self-employed and Energy and is regulated by the law of 13 June 1969 ([Reglementering Zand- en Grindwinning in het BNZ 2014](#)). The coordination of the parties involved in the management of the exploration and exploitation on the continental shelf (CS) and in the territorial sea is executed by an advisory committee (royal decree of 12 August 2000).

4.2 Spatial use

The various zones for sand and gravel extraction are legally demarcated in the marine spatial plan (royal decree of 20 March 2014, see also [Van de Velde et al. 2014](#)). In order to monitor the impact on the environment, a reference zone where extraction is prohibited, has been delineated. This area is located on the Thornton Bank (see zone THBREF in figure 1).

The geographical demarcation and accessibility of the zones for the exploitation and exploration of mineral and other non-living resources in the territorial sea and on the continental shelf have been registered in the royal decree of 1 September 2004 (table 1 and figure 1, recently changed by the royal decree of 19 April 2014) (see also [Reglementering Zand- en Grindwinning in het BNZ 2014](#)). Prior to this demarcation, a study about the possible concession zones for sand extraction was conducted ([Schotte 1999](#)). In total, three control zones¹ were demarcated (in 2004) and divided into sectors for which concessions can be obtained. A fourth control zone was defined in 2010, in which 4 new sectors were demarcated based on new exploration data. If a negative seabed evolution occurs due to extraction that does not meet the legal requirements (max. 5 m relative to a reference level), certain sections of the zones can be closed.

Table 1. An overview of the different control zones for sand extraction in the Belgian part of the North Sea (BNS) with their location and accessibility.

CONTROL ZONE	SECTOR	LOCATION	ACCESSIBILITY
1	A	Thornton Bank	Open, except for the area THBREF
	KB	Kwinte Bank	Open, except for KBMA and KBMB
2	BR	Buiten Ratel	Open, except for BRMC
	OD	Oostdyck	Open
3	A	Sierra Ventana	Open
	B	Sierra Ventana	Closed as long as the sector is used as a dumping site for dredged material
	A	Noordhinder	Open
4	B	Oosthinder	Open
	C	Oosthinder	Open
	D	Westhinder	Open

¹ A control zone is a legally defined area where sand extraction is allowed (see demarcation in the marine spatial plan – royal decree of 20 March 2014).

THE DEMARCATION OF THE CONTROL ZONES FOR SAND EXTRACTION ON THE BCS

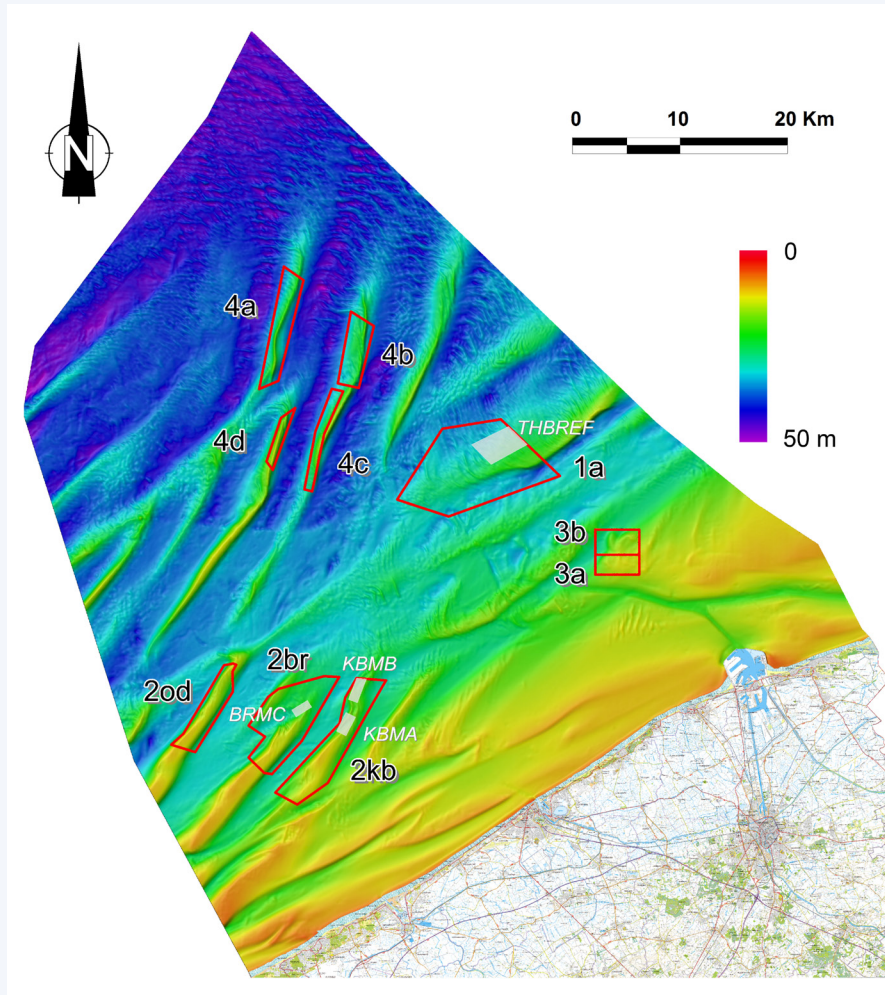


Figure 1. The demarcation of the control zones for sand extraction in the BNS (Source: [website FPS Economy](#)).

The offshore extraction of sand and gravel requires a concession permit (see figure 2). In order to obtain a permit, an application form has to be submitted to the director of the General Direction Quality and Safety of the FPS Economy, according to the procedure stipulated in the royal decree of 1 September 2004 concerning the granting procedure. Furthermore, the royal decree of 1 September 2004 about the environmental impact assessment (EIA) defines that an environmental impact report has to be submitted to the Management Unit of the North Sea Mathematical Models (MUMM) (RBINS) (*MER voor de extractie van mariene aggregaten op het BNZ, 2006*, *MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010*). The EIA by MUMM (*milieueffectenbeoordeling Pichot 2006*) is subsequently transferred to the minister/state secretary competent for the marine environment, who in turn formulates a binding recommendation to the federal minister competent for economy (Source: *Reglementering Zand- en Grindwinning in het BNZ 2014*).

The concessions that have been granted for the exploration and exploitation of the mineral and other non-living resources in the BNS are to be found in the ministerial decrees in the Belgian Official Gazette (*Belgisch staatsblad*) (see table 2).

PROCEDURE FOR A CONCESSION PERMIT AND THE EXPLOITATION OF SAND AND GRAVEL EXTRACTION IN THE BNS

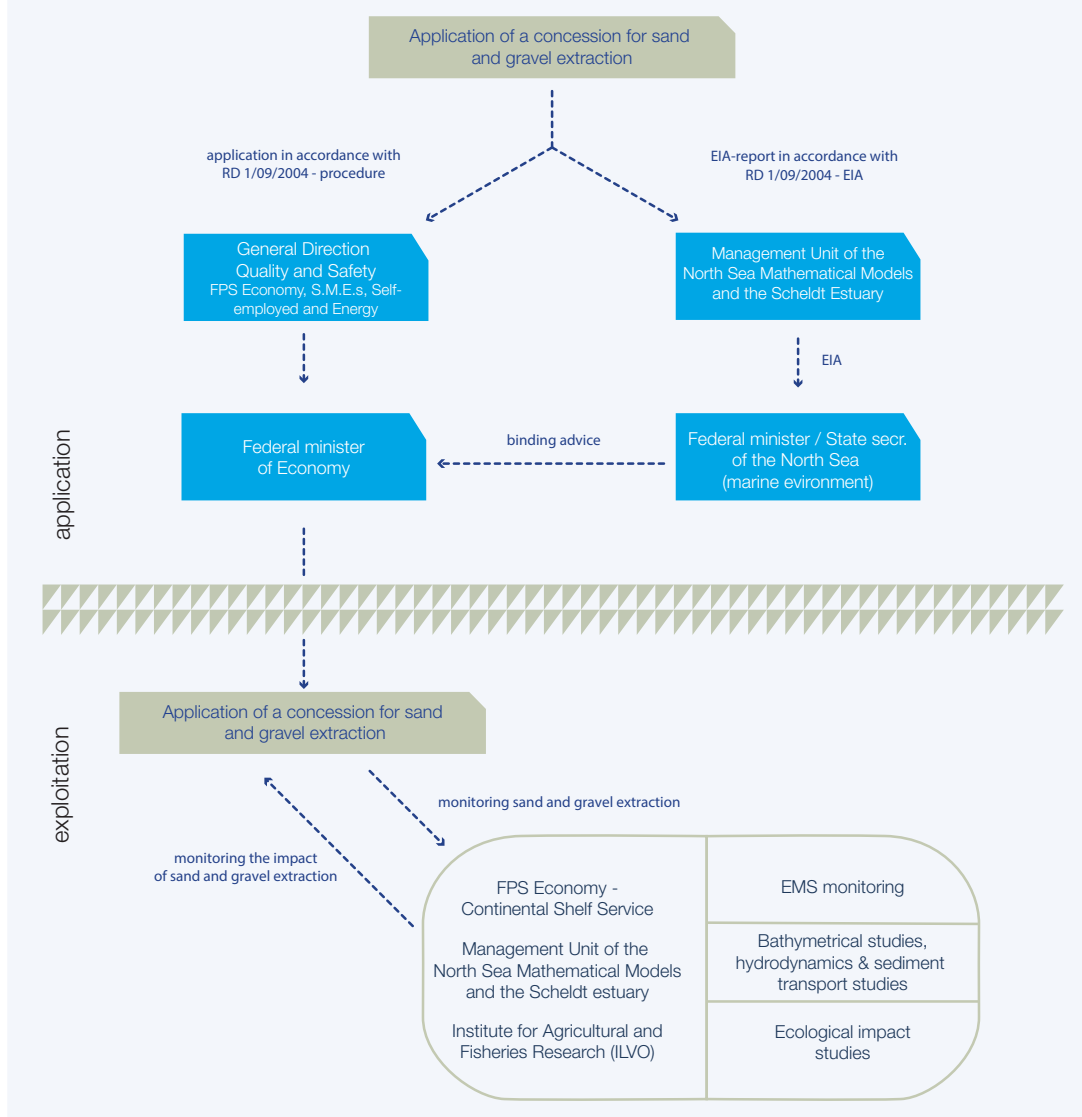


Figure 2. Flowchart of the procedure for a concession permit and the exploitation of sand and gravel extraction in the BNS (law of 13 June 1969 and associated implementation decisions).

4.3 Societal interest

The extraction of sand and gravel in the BNS has strongly increased over the past few years (see figure 3). In 1976, a sediment volume of 29,000 m³ was extracted; this volume amounted to 5.82 million m³ in 2014. A volume of approximately 4 million m³ was reached in 1997 due to the construction of submarine pipelines (Interconnector and Norfra) (Goffin *et al.* 2007, André *et al.* 2010, see also theme **Energy (incl. cables and pipelines)**). Between 2003 and 2010, more than 75% of the sediment was extracted in zone 2 with a gradual shift from sectors 2KB to 2BR. Furthermore, a significant volume of sand was exploited in zone 1 on the Thornton Bank (Degrendele *et al.* 2014). Currently, a maximum of 15 million m³ of sediment can be extracted in the control zones over a period of 5 years (this number does not take into account exceptional projects such as coastal protection). The extracted sediment is mainly landed in Flanders, although some sediment is also landed in ports in France and the Netherlands (up to 16% in 2007) (De Smet *et al.* 2009).

Table 2. An overview of the concessionaires for sand extraction in the BNS with the maximum extraction volume for 2015 (Source: FPS Economy, Continental Shelf service).

CONCESSIONAIRE	MAXIMUM EXTRACTION VOLUME FOR 2015
Betoncentrale Van den Braembussche NV	100,000 m ³
Charles Kesteleyn NV	100,000 m ³
Dranaco NV	100,000 m ³
CEI - De Meyer NV (will merge into Van Oord Belgium NV)	140,000 m ³
Satic NV	150,000 m ³
De Hoop Bouwgrondstoffen BV c.o. Satic NV	150,000 m ³
TV Zeezand Exploitatie NV	175,000 m ³
Alzagri NV	200,000 m ³
Flemish government – Maritime Access division	350,000 m ³
Belmagri NV	500,000 m ³
DC Industrial NV	500,000 m ³
Nieuwpoortse Handelsmaatschappij NV	550,000 m ³
DEME Building Materials NV	600,000 m ³
CBR Cementbedrijven NV (division Sagrex)	600,000 m ³
Flemish government – Coastal division	1,750,000 m ³ and 2,000,000 m ³ (Masterplan Coastal Safety)

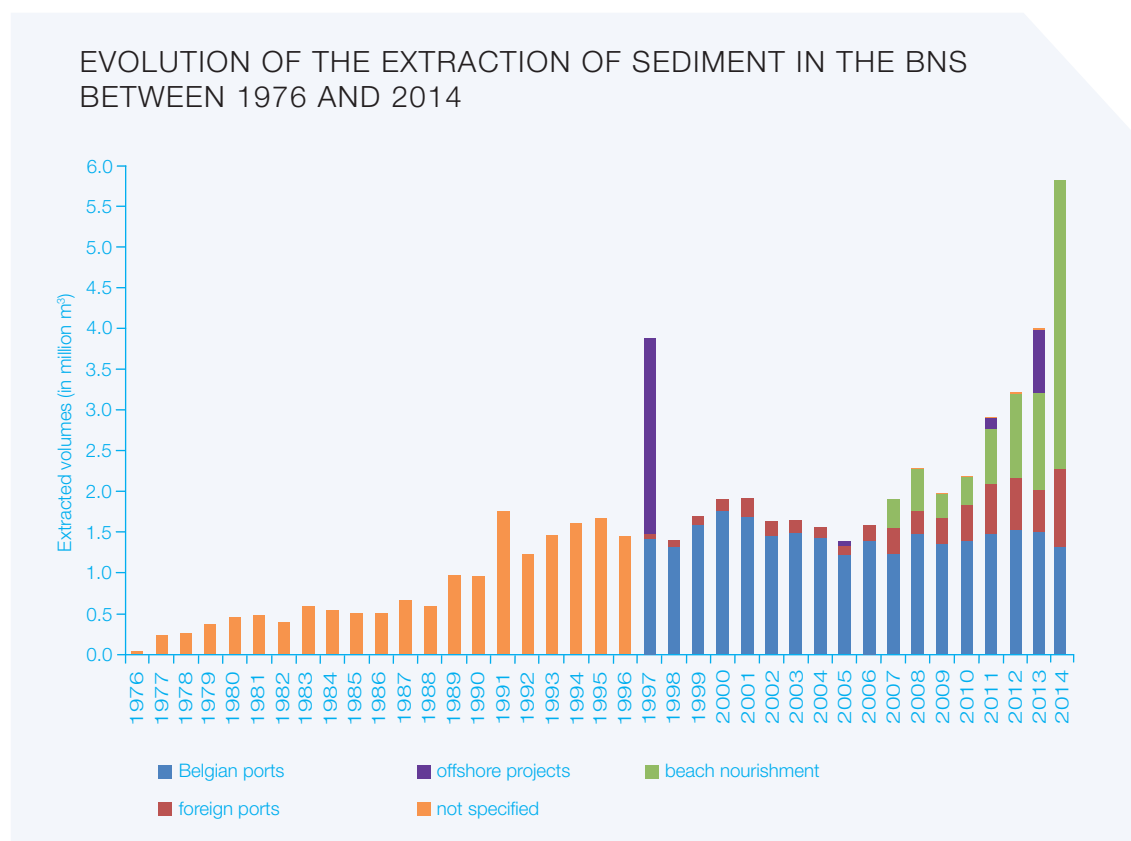


Figure 3. The evolution of the extraction of marine sand in the BNS between 1976 and 2014. Comment: Construction of submarine pipelines in 1991 and 1997 (Source: FPS Economy, Continental Shelf service).

The sediments from the BNS constitute an important source of construction materials. The application of the sediment mainly depends on the quality and the grain size. Sand is mostly used in the concrete industry (sand with a grain size of > 500 µm and with a certain distribution and consistency of the grain), but it can also be used as filling material or as raw material for asphalt production ([Van De Kerckhove 2011](#), [Brochure Continental Shelf service 2014](#)). In recent years, the extracted sediments have also been used for coastal protection (beach nourishments) ([Van Quickelborne 2014](#)) and other maritime works such as the construction of offshore wind farms ([Vanden Eede et al. 2014](#)).

Recently, new concession zones have been defined in the Hinder Banks region. These zones should provide 35 million m³ of sediment over the next 10 years in the context of the Masterplan Coastal Safety and the OW plan (plan for the coastal safety and the maritime accessibility of Ostend) in Ostend ([MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010](#), [Mathys et al. 2011](#), [Rumes et al. 2011](#)). Sand which is used for beach nourishments usually has a grain size of 250-350 µm (D50) and ± 200 µm (D50) for foreshore replenishments (see theme [Safety against flooding](#)).

No recent data is available about the economic value of the sand extraction sector in the BNS. In a study by Zeegra vzw concerning the economic importance of sand extraction in the BNS ([het economisch belang van de sector van zandwinning op zee in België \(2004\)](#)), an estimation was made of the employment (295 persons), turnover (264,931,000 euro, based on 19 out of 22 companies that were active in the BNS) and gross value added (31,245,000 euro) in 2002. The feasibility study ([haalbaarheidsstudie, 2010](#)) of npo Flanders Marine (the current [Flanders Maritime Cluster](#)) gives a rough estimate of the employment in the sector of the extraction of natural resources compared to the total marine/maritime sector in 2008.

4.4 Impact

The most commonly used vessel for sand extraction is the trailing suction hopper dredger, which makes channels of 1-3 m wide and 0.2-0.5 m deep in the seabed ([Degrendele et al. 2010](#), [Newell & Woodcock 2013](#)). The royal decree of 1 September 2004 regarding the environmental impact assessment, stipulates the different effects of sand extraction on the marine environment that need to be taken into account in the environmental assessment report (tables 3 and 4).

Table 3. An overview of the effects of sand extraction on the environment.

ENVIRONMENTAL IMPACT	LITERATURE
Seabed and water (changes in the bathymetry, sedimentology, sediment plumes, turbidity, hydrodynamic regime, etc.)	Verfaillie et al. 2005 (GAUFRE project BELSPO) , MER voor de extractie van mariene aggregaten op het BNZ, 2006 , Van Lancker et al. 2007 (MAREBASSE project BELSPO) , Vanaverbeke et al. 2007 (SPEEK project BELSPO) , Van Lancker et al. 2009 (QUEST4D project BELSPO) , MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010 , Van Lancker et al. 2010 , Bellec et al. 2010 , Degrendele et al. 2010 , Van den Eynde et al. 2010 , Garel 2010 , Roche et al. 2011 , De Sutter & Mathys 2011 , Van Lancker et al. 2014a , Degrendele et al. 2014 , Van Lancker et al. 2014b , Francken et al. 2014 , Van Lancker et al. 2015 , Van Lancker & Baeye 2015
Fauna, flora and biodiversity	Verfaillie et al. 2005 (GAUFRE project BELSPO) , MER voor de extractie van mariene aggregaten op het BNZ, 2006 , Vanaverbeke et al. 2007 (SPEEK project BELSPO) , MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010 , De Backer et al. 2010 , Bonne 2010 , De Backer et al. 2011 , De Sutter & Mathys 2011 , De Backer et al. 2014a , De Backer et al. 2014b , De Backer & Hostens 2014 , Van Lancker et al. 2014a , Van Lancker et al. 2014b , Van Lancker et al. 2015
Air quality and climate	MER voor de extractie van mariene aggregaten op het BNZ, 2006 , MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010 , De Sutter & Mathys 2011
Noise and vibrations	MER voor de extractie van mariene aggregaten op het BNZ, 2006 , MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010 , De Sutter & Mathys 2011

Table 4. An overview of the effects of sand extraction on the other users.

IMPACT ON USERS	LITERATURE
Risks and safety (shipping, oil pollution, coastal protection, etc.)	<i>MER voor de extractie van mariene aggregaten op het BNZ, 2006, Verwaest 2008, MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010, De Sutter & Mathys 2011</i>
Seascape and cultural heritage	<i>MER voor de extractie van mariene aggregaten op het BNZ, 2006, MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010, De Sutter & Mathys 2011, Van Haelst & Pieters 2014</i>
Interaction with other human activities (incl. coastal protection)	<i>Verfaillie et al. 2005 (GAUFRE project BELSPO), Verwaest & Verelst 2006, MER voor de extractie van mariene aggregaten op het BNZ, 2006, Verwaest 2008, MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010, De Sutter & Mathys 2011, Vandenborre 2014</i>
Cumulative effects (e.g. in combination with activities in the offshore wind farms)	<i>MER voor de extractie van mariene aggregaten in de exploratiezone van het BNZ, 2010, De Sutter & Mathys 2011, Van Lancker et al. 2015</i>

4.5 Sustainable use

Within the OSPAR Region, all countries that extract sand and gravel on a large scale have legislation that complies with the European directive 85/337/EEC concerning the environmental impact assessment of specific public and private projects, as well as with the European Habitats Directive. With regard to the management of marine sediment extraction, the OSPAR Countries have agreed to apply the directives as proposed by the International Council for the Exploration of the Sea (ICES) (see annex 10 of *Report of the Working Group on the effects of extraction of marine sediments on the marine ecosystem (ICES, WGEXT) 2003*). These also discuss nature conservation and spatial conflicts between users. Belgium, Denmark, Germany, France, the Netherlands and the United Kingdom demand the use of 'black box' systems which monitor the extraction in space and time. The effects of the sand and gravel extraction on the marine environment are examined by the ICES working group *WGEXT*. Belgium is represented in this working group by *MUMM* (RBINS) and the Institute for Agricultural and Fisheries Research (*ILVO*).

At the European level, the impact on the marine environment caused by the extraction of sediments is also included in the Marine Strategy Framework Directive (2008/56/EC) (MSFD, see also royal decree of 23 June 2010) (*Degraer & Vanden Berghe 2014*). In the MSFD, several descriptors for a good environmental status (GES) are identified, some of which are relevant for the extraction of marine sediments: seafloor integrity (more information: *Rice et al. 2010*), underwater noise and other forms of energy (more information: *Tasker et al. 2010*) and the permanent alteration of the hydrographical conditions. Furthermore, the descriptors biodiversity (more information: *Cochrane et al. 2010*) and marine food chain (*Rogers et al. 2010*) are (indirectly) affected by the extraction of sediments. The selective extraction due to exploration and exploitation of living and non-living resources on the seabed and subsoil is listed among the pressures and impacts. The European Habitats Directive (92/43/EEC) (see also royal decree of 14 October 2005) offers a framework to protect ecologically important areas such as the gravel beds in the BNS (*Degrendele et al. 2008, Houziaux et al. 2008, Degraer et al. 2009, Raeymaekers et al. 2011*) against pressures such as sediment extraction. The most ecologically valuable natural gravel beds are located south of the extraction areas of the Hinder Banks. In the context of the two aforementioned directives, the sediment mobility in the gravel beds has been incorporated into the monitoring programme (Flemish government) related to the sand extraction (*Van Lancker et al. 2014a, Van Lancker et al. 2014b, Van Lancker et al. 2015*). In the marine spatial plan (royal decree of 20 March 2014, see also *Van de Velde et al. 2014*) a reference zone has been demarcated in order to monitor the impact on the environment, and in the habitats directive area Flemish Banks the extraction activities have been limited (control zone 2). The maximum volume that can be extracted in this zone decreases annually with 1% (17,000 m³) and gravel extraction is prohibited.

The sand and gravel extraction in the BNS is monitored by the Continental Shelf service (FPS Economy), MUMM and ILVO (*Brochure Continental Shelf service 2014, Reglementering Zand- en Grindwinning in het BNZ 2014, Degrendele et al. 2014, Van Lancker et al. 2014, De Backer et al. 2014*). Each concessionaire needs to pay a fee in proportion to the extracted volume. This fee is used to fund the ongoing research on the impact of exploitation and exploration

activities on the marine environment and the seabed ([Degrendele 2008](#), [Brochure Continental Shelf service 2014](#), [Reglementering Zand- en Grindwinning in het BNZ 2014](#)). Every three years, the monitoring results are presented at a conference organized by the Continental Shelf service (e.g. [De Mol & Vandenreyken 2014](#)).

The extraction activities are controlled by means of the registers of the dredgers on the one hand and by means of the 'black box' system (Electronic Monitoring System, EMS) on the other ([Brochure Continental Shelf service 2014](#), [Reglementering Zand- en Grindwinning in het BNZ 2014](#), [Van den Branden et al. 2014](#)). This system was introduced in 1996, modernized in 2014 and is managed by MUMM, as commissioned by the Continental Shelf service ([Degrendele 2008](#), [Degrendele et al. 2014](#)). Furthermore, the physical impact of extraction on the seabed is monitored by the Continental Shelf service and MUMM. The sediment volumes in the control zone are followed up by means of the research vessel Belgica. In this regard, a maximum of 5 m of sediment may be removed compared to the original level of the seabed ([Degrendele et al. 2014](#)). Currently, the possibility for a new reference level for sand extraction is being explored ([De Mol et al. 2014](#)). MUMM is responsible for monitoring the hydrodynamics and the sediment transport by means of models and measurements ([Van Lancker et al. 2014a](#), [Van Lancker et al. 2014b](#), [Francken et al. 2014](#)). The biological environment research group of ILVO examines the ecological impact of the extraction activities as well as the biological evolution after cessation of the activities ([De Backer et al. 2014](#), [De Backer & Hostens 2014](#)). In exploitation zone 4 (demarcated in 2010) an elaborate 'baseline' study has been executed to estimate the impact of the current extraction activities ([Mathys et al. 2011](#), [Van Lancker et al. 2014a](#)).

Furthermore, specific studies and research projects such as *BUDGET* ([Lanckneus et al. 2001](#), *BUDGET project BELSPO*), *SPEEK* ([Vanaverbeke et al. 2007](#), *SPEEK project BELSPO*), *MAREBASSE* ([Van Lancker et al. 2007](#), *MAREBASSE project BELSPO*), *EUMARSAND* ([Van Lancker et al. 2010](#), EU-FP6-project), *QUEST4D* ([Van Lancker et al. 2009](#), *QUEST4D project BELSPO*) and *TILES* (*TILES project BELSPO*) ([Van Lancker et al. 2014b](#)) contribute to a better understanding of the impact and a sustainable management of the sand and gravel extraction. In the *TILES* project a harmonized geological basic knowledge is developed which supports natural resource management in the Belgian and Dutch part of the North Sea in the long term. The basis of this project is constituted by 3D geological models that map the quality and quantity of the exploitable geological layers. By linking this to numeric impact models, threshold values are defined with regard to sustainable exploitation. The generated knowledge and information will be made available in a multi-criteria decision support system.

Legislation reference list

Table with European legislation. The consolidated version of this legislation is available on [Eurlex](#).

EUROPEAN LEGISLATION			
Abbreviations (if available)	Title	Year	Number
Directives			
<i>EIA Directive</i>	Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment	1985	337
<i>Habitats Directive</i>	Directive on the conservation of natural habitats and of wild fauna and flora	1992	43
<i>Marine Strategy Framework Directive</i>	Directive establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive)	2008	56

Table with Belgian and Flemish legislation. The consolidated version of this legislation is available on [Belgisch staatsblad](#) and the [Justel-databases](#).

BELGIAN AND FLEMISH LEGISLATION		
Date	Title	File number
Laws		
Wet van 13 juni 1969	Wet inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat	1969-06-13/30
Royal Decrees		
KB van 12 augustus 2000	Koninklijk besluit tot instelling van de raadgevende commissie belast met de coördinatie tussen de administraties die betrokken zijn bij het beheer van de exploratie en de exploitatie van het continentaal plat en van de territoriale zee en tot vaststelling van de werkingsmodaliteiten en –kosten ervan	2000-08-12/83
KB van 1 september 2004 – toekenningsprocedure	Koninklijk besluit betreffende de voorwaarden, de geografische begrenzing en de toekenningsprocedure van concessies voor de exploratie en de exploitatie van de minerale en andere niet-levende rijkdommen in de territoriale zee en op het continentaal plat	2004-09-01/51
KB van 1 september 2004 – milieueffectenbeoordeling	Koninklijk besluit houdende de regels betreffende de milieu-effectenbeoordeling in toepassing van de wet van 13 juni 1969 inzake de exploratie en exploitatie van niet-levende rijkdommen van de territoriale zee en het continentaal plat	2004-09-01/50
KB van 14 oktober 2005	Koninklijk besluit tot instelling van speciale beschermingszones en speciale zones voor natuurbewoud in de zeegebieden onder de rechtsbevoegdheid van België	2005-10-14/35
KB van 23 juni 2010	Koninklijk besluit betreffende de mariene strategie voor de Belgische zeegebieden	2010-06-23/05
KB van 20 maart 2014	Koninklijk besluit tot vaststelling van het marien ruimtelijk plan	2014-03-20/03
KB van 19 april 2014	Koninklijk besluit tot wijziging van verscheidene koninklijke besluiten betreffende de exploratie en de exploitatie van de minerale en andere niet-levende rijkdommen in de territoriale zee en op het continentaal plat	2014-04-19/49

